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Item 4(a) of the provisional agenda
**Heavy duty vehicles - Regulations Nos. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines) and 132 (Retrofit Emissions Control devices (REC))**

# Proposals for a new Supplement to the 06 series of amendments to Regulation No. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines)

## Submitted by the expert from the International Organization of Motor Vehicle Manufacturers*

The text reproduced below was prepared by the expert from the International Organization of Motor Vehicle Manufacturers (OICA) to improve the Engine Control Unit (ECU) torque signal validation requirement in the 06 series of amendments to Regulation No. 49. The present provisions force manufacturer to deliberately decrease accuracy of torque signal in case of additionally declared market fuels. The proposal takes into account the draft Supplement 5 to the 06 series of amendments to Regulation No. 49 adopted at the last session of the Working Part on Pollution and Energy (GRPE) (see report ECE/TRANS/WP.29/GRPE/75, para. 21), subject to the final adoption of ECE/TRANS/WP.29/2017/130 by the World Forum for Harmonization of Vehicle Regulations (WP.29) and the Administrative Committee (AC.1) of the 1958 Agreement at their November 2017 sessions. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2014–2018 (ECE/TRANS/240, para. 105 and ECE/TRANS/2014/26, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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# I. Proposal

*Paragraph 4.6.2.*, amend to read:

"4.6.2. If the manufacturer permits the engine family to run on market fuels that do not comply neither with the reference fuels included in Annex 5 nor CEN standard EN 228 (in the case of unleaded petrol) or CEN standard EN 590 (in the case of diesel), such as running on FAME B100 (CEN standard EN14214), FAME diesel blends B20/B30 (CEN standard EN 16709), paraffinic fuel (CEN standard EN 15940) or others the manufacturer shall, in addition to the requirements in paragraph 4.6.1. comply with the following requirements:

(a) Declare the fuels the engine family is capable to run on in paragraph 3.2.2.2.1. of the Information Document as set out in Part 1 of Annex 1, either by reference to an official standard or to a production specification of a brand specific market fuel not meeting any official standard such as those mentioned in paragraph 4.6.2. The manufacturer shall also declare that the functionality of the OBD system is not affected by the use of the declared fuel;

(b) **Determine the power correction factor for each fuel declared according to paragraph 9.4.2.8. if applicable according to the provisions specified in paragraph 9.4.2.7. Declare the factor for each fuel in 3.2.2.2.2. of the information document as set out in Part 1 of Annex 1 if applicable;**

(c) Demonstrate that the parent engine meets the requirements specified in Annex 4 and in Appendix 1 of Annex 10 to this Regulation on the fuels declared; the approval authority may request that the demonstration requirements be further extended to those laid down in Annex 7 and Annex 9A;

**(d)** Be liable to meet the requirements of in-service conformity specified in Annex 8 on the fuels declared, including any blend between the declared fuels and the relevant market fuels and standards.

At the request of the manufacturer, the requirements set out in this paragraph shall be applied to fuels used for military purposes.

For the purposes of subparagraph 4.6.2.(a) where the emission tests are performed for demonstrating compliance with the requirements of this Regulation, a fuel analysis report of the test fuel shall be attached to the test report and shall comprise at least the parameters specified in the official specification of the fuel manufacturer."

*Paragraphs 9.4.2.5. to 9.4.3.3.1.*, amend to read:

"9.4.2.5. The average load at each operating condition in Nm calculated from the information requested in point 9.4.2.1. shall not differ from the average measured load at that operating condition by more than:

(a) 7 per cent when determining the engine power according to Regulation No. 85;

(b) 10 per cent when performing the World Harmonised Steady state Cycle (hereinafter "WHSC") **except for mode 1 and 13 (idle modes)** according to Annex 4, paragraph 7.7.

Regulation No. 85 allows the actual maximum load of the engine to differ from the reference maximum load by 5 per cent in order to address the manufacturing process variability. This tolerance is taken into account in the above values.

9.4.2.6. External access to the information required in point 9.4.2.1. shall not influence the vehicle emissions or performance.

**9.4.2.7. If the manufacturer permits to operate an engine family to run on market fuels according to paragraph 4.2.6. the calculated torque built by the ECU may comply also for those fuels with the requirements specified in paragraph 9.4.2.5. If in case of a CI engine the difference between the measured torque value obtained with a declared market fuel and the torque calculated from the information requested in point 9.4.2.1. exceeds one of the values specified in point 9.4.2.5. the following paragraph 9.4.2.8 applies.**

**9.4.2.8. A power correction factor for each additional market fuel permitted by the manufacturer according to paragraph 4.2.6. shall be determined for the engine family. The correction factor shall be calculated from the relation between average measured peak torque with each market fuel declared and average measured peak torque with reference fuel according to Annex 5.**

$$CP\ fuel_{declared} = \frac{M\ fuel_{ref}}{M\ fuel_{declared}}$$

**Where:**

***M* fuel$_{declared}$ is the peak torque with the market fuel declared, Nm**

***M* fuel$_{ref}$ is the peak torque with the dedicated reference fuel, Nm**

9.4.3. Verification of the availability and conformity of the ECU information required for in-service testing

9.4.3.1. The availability of the data stream information required in point 9.4.2.1. according to the requirements set out in point 9.4.2.2. shall be demonstrated by using an external OBD scan-tool as described in Annex X.

9.4.3.2. In the case where this information cannot be retrieved in a proper manner, using a scan-tool that is working properly, the engine is considered as non-compliant.

9.4.3.3. The conformity of the ECU torque signal to the general requirements ~~of points 9.4.2.2. and 9.4.2.3.~~ **specified in paragraph 9.4.2.** shall be demonstrated when determining the engine power according to Annex XIV and when performing the WHSC test according to Annex III.

9.4.3.3.1. The conformity of the ECU torque signal to the requirements of paragraphs 9.4.2.~~3. and 9.4.2.3.~~ shall be demonstrated for each engine family member when determining the engine power according to Regulation No. 85. For this purpose additional measurements shall be performed at several part load and engine speed operating points (for example at the modes of the WHSC and some additional random points). **If applicable the power**

**correction factor for the engine family according to 9.4.2.8. shall be determined with the parent engine of the engine family."**

*Annex 1,*

*Part 1.* amend to read:

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.2.2. | Fuel | | | | | | |
| 3.2.2.2. | Heavy duty vehicles Diesel/Petrol/LPG/NG-H/NG-L/NG-HL/Ethanol (ED95)/ Ethanol (E85)[1] | | | | | | |
| 3.2.2.2.1. | Fuels compatible with use by the engine declared by the manufacturer in accordance with paragraph 4.6.2. of this Regulation (as applicable) | | | | | | |
| **3.2.2.2.2.** | **Power correction factor according to paragraph 9.4.2.8. for each fuel declared (if applicable)** | | | | | | |

"

*Annex 8,*

*Paragraphs 4.4.2. and 4.4.2.1.*, amend to read:

"4.4.2. Fuel

The test fuel shall be market fuel covered by the relevant standards or reference fuel as specified in Annex 5 to this Regulation. ~~**Fuel samples shall be taken.**~~

4.4.2.1. If the manufacturer in accordance with paragraph 4. to this Regulation has declared the capability to meet the requirements of this Regulation on market fuels declared in paragraph 3.2.2.2.1. of Part 1 of Annex 1 to this Regulation, tests shall be conducted on at least one of the declared market fuels ~~**or blend between the declared market fuels and the market fuels covered by the relevant standards.**~~"

*Insert a new paragraph 4.4.2.2.*, to read:

**"4.4.2.2. Fuel samples shall be taken."**

*Annex 8, Appendix 1,*

*Insert a new paragraph A.1.4.2.1.1.*, to read:

**"A.1.4.2.1.1. Calculation of the specific emissions for a declared market fuel**

**If a test according to this Annex was performed with a market fuel declared in paragraph 3.2.2.2.1. of Part 1 of Annex 1 to this Regulation and a power correction factor in accordance with paragraph 3.2.2.2.2. of Part 1 of Annex 1 to this Regulation was documented for the market fuel used for the test, the specific emissions $e_{gas}$ (mg/kWh) shall be calculated for each window and each pollutant in the following way:**

$e_{gas,korr} = e_{gas} \times CP\ fuel_{declared}$

**Where:**

| | |
|---|---|
| $e_{gas}$ | **is the specific emission (mg/kWh) according to A.1.4.2.1.** |
| $CP\ fuel_{declared}$ | **is the applicable power correction factor for the market fuel declared according to paragraph 3.2.2.2.2. of Part 1 of Annex 1 to this Regulation."** |

*Annex 8, Appendix 4,*

*Insert a new paragraph A.4.2.1.1.*, to read:

"**A.4.2.1.1. If a market fuel declared in paragraph 3.2.2.2.1. of Part 1 of Annex 1 to this Regulation is used and a power correction factor in accordance with paragraph 3.2.2.2.2. of Part 1 of Annex 1 to this Regulation was documented for the dedicated market fuel used for the test, the ECU torque signal has to be corrected with this documented correction factor when it will be verfied with the reference maximum torque curve performed with this specific market fuel."**

## II. Justification

1. The manufacturer can permit the use of an alternative fuel in addition to the standard fuel for which the engine is specified and certified with a defined reference fuel specified in the Regulation. If the manufacturer will do so according to the Regulation the engine must comply as specified in the information document also with the alternative fuel (e.g. Biodiesel or paraffinic fuel, etc…) with the requirements set in this Regulation. This has to be demonstrated during type approval and for in-service conformity. For example the engine is a compression ignition engine and the specified in-use fuel is diesel fuel according to EN 590 it has to comply with reference fuel and additionally with the alternative market fuel specified.

2. The problem in the present stage of the Regulation is the demonstration of the Engine Control Unit (ECU) torque data accuracy for this kind of "flex-fuel" approval. This information will be provided by the On-Board Diagnostic (OBD) interface for in-service conformity testing with Portable Emissions Measurement Systems (PEMS). Usually the heat values of the standard and alternative fuel are different and the information which fuel is used cannot be sensed and submitted automatically to the ECU. The ECU torque information can be calibrated only to one fuel standard (heat value), usually it will be to the basic standard fuel (i.e. reference fuel). But the Regulation requires certain accuracy with both fuels. This can be solved very often only if the whole tolerance band will be used leading to a signal with less accuracy for both fuels. In some cases it is very often extremely difficult to meet this requirement by this kind of "miss-calibration". Nevertheless the physical power difference will remain.

3. To increase the accuracy of the torque values used for calculating the emission results during in-service conformity testing OICA proposes to change the provisions in order to:

(a) Either demonstrate that both fuels comply because the system is able to detect the fuel used,

(b) Or alternatively to determine the torque deviation caused by the alternative fuel heat value compared to the standard fuel. This torque deviation will be documented in the information document as a power correction factor. Using this correction factor the ECU power submitted from the ECU during PEMS testing with an alternative fuel can be converted to a correct and true power signal for emission calculation.